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UNITED STATES BUREAU OF MINES
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MARKETS FOR RESIDENTIAL STONE

BY

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INTRODUCTION

A primary function of the Bureau of Mines is to encourage elimination of waste and the most profitable use of mineral raw materials. In line with this objective the Bureau has frequently stressed the importance of waste utilization at stone quarries. From time to time studies both technical and economic in character have been made of problems pertaining to the most efficient use of natural stone, particularly that which may be classed as a by-product of the higher grades of dimension stone.

Every quarry producing ornamental or building stone yields large quantities of material that for one reason or another is unsuited for high-grade products, even though a great deal of work has been expended upon it more or less unavoidably. It is obviously good judgment to sell this odd-sized or off-grade stone at whatever price can be obtained rather than to spend more money to place it on the waste dump. In many cases, however, a really profitable side line has been developed.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6749."

[2] Mining engineer, building materials section, U. S. Bureau of Mines.

The field of medium-priced home construction appears to be one of the most attractive outlets for stone of this character. A number of dimension-stone producers have cultivated this market to some extent, but the field offers far greater possibilities than have yet been realized.

Residential construction was at an abnormally low rate during 1932 because of general postponement of building projects, but this condition cannot be expected to continue indefinitely. Some authorities believe, in fact, that residential construction will be one of the first industries to recover. Figure 1 shows the importance of this market and the extent to which residential contracts have declined from the peak years before the depression. Steady growth in population, fire losses, obsolesence, and depreciation are constantly operating to create shortages in housing facilities in most communities; and returning purchasing power, and sound banking and financial conditions tend to convert this accumulated demand into an effective stimulant to the construction industry.

The producer of residential building stone finds many satisfactory building materials on the market with which his product may be used. Among these are wood, stucco, concrete, various artificial stone products, and brick, hollow tile, and other ceramic materials. Each has its legitimate place in residential construction, and all of them are used in combination with stone to produce the great variety of artistic effects popular even in smaller communities.

The purpose of this paper is to outline in a general way the possibilities open to the stone producer or contractor in the residential market. The data given are meant to be suggestive of further lines of study rather than exhaustive in themselves. In preparing this report the author wishes to acknowledge the helpful cooperation of the North Carolina Granite Corporation, the Cleveland Quarries Co., the Indiana Limestone Corporation, and the Briar Hill Stone Co.

THE BUILDING STONES

Virtually any stone that is sound structurally, amenable to shaping, pleasing in appearance, and available to the markets can be utilized for residential construction. The more common natural stones now being offered to the consumer include granite, limestone, marble, sandstone, and slate. Granite, limestone, and sandstone are used extensively for wall construction, marble is used widely as interior trim, and slate is much used as roofing material, although an important use is for flagstones. The usefulness of the various natural stones depends mainly upon inherent physical properties such as durability, strength, color, and texture. Being products of nature's workshop, they all vary in composition and physical characteristics depending upon the geological processes by which they have been made.

Granite is among the most ancient of rocks, formed ages ago by slow cooling of molten mineral matter under pressure and now exposed for use through long erosion. It consists chiefly of interlocked quartz, feldspar, and mica

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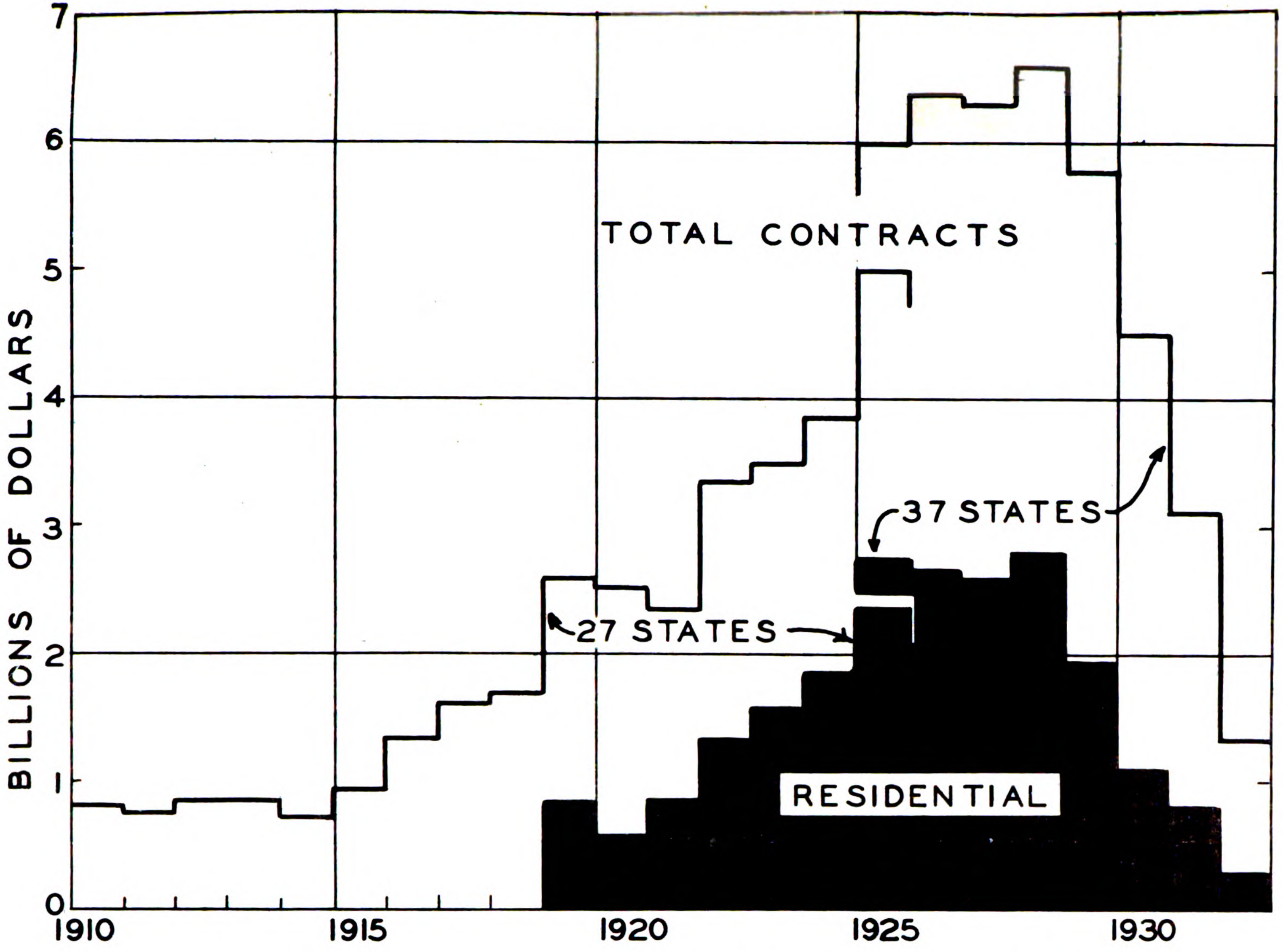

Figure 1.—Construction contracts awarded in 27 States from 1910 to 1925 and in 37 States from 1925 to 1932. (Data from F. W. Dodge Corporation.)

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crystals firmly welded together. Shades of gray and pink or red are the most common color effects, the quartz usually being transparent to gray, the feldspar gray to different shades of pink or red, and the mica relieving the ground mass with darker shades of gray to black or sometimes yellow coloring. The texture may be fine- or coarse-grained. Sound granite is strong structurally, is dense and therefore relatively impervious to water, and is very durable. Granite as a commercial term includes not only the true granite of the geologist, but also certain varieties of metamorphic rocks such as some schists and gneisses. Certain of these stones cleave or break readily along parallel planes, whereas most true granites have less tendency to break in well-defined directions, although they may be fractured along the rift and grain. The rift is the direction of easiest splitting; the grain, at right angles to the rift, is less easy to split than the rift yet easier than the "hard way" which presents the greatest resistance to breakage and is at right angles to both rift and grain.

Limestone is a term broadly applied to sedimentary rocks composed essentially of calcium carbonate with or without magnesium carbonate. Most of the popular building limestones consist chiefly of calcium carbonate. Limestones vary in color from pure white to black, but those most used for building vary through shades of cream, buff, or gray. The texture may be fine-grained to coarse-grained, some varieties being distinctly crystalline. Limestone is a relatively soft material yet possesses ample strength and marked durability. Some limestones occur with many bedding planes of varying thicknesses but other varieties are homogeneous and break with equal facility in any direction.

Marble is a recrystallized limestone, which has become dense and relatively hard through subjection to heat and pressure. Marble polishes readily and is available in many shades of color. Occasionally other rocks, notably serpentine, have similar physical properties and are commercially classed as marble.

Travertine, another variety of limestone, is a product of mineral springs. Its banded and porus texture combined with warm shades of color produce unique and interesting effects.

Sandstone, also a sedimentary rock, is composed mainly of quartz grains cemented together. The color generally is gray, cream, or buff to different shades of brown, pink, or red. Sandstone may be friable if loosely cemented or may be very hard and compact with little or no evidence of bedding planes. When so tightly compacted and cemented as to have lost the structure of the original sand grains it is called quartzite. Most building sandstones are moderately cemented, thus having adequate strength as well as easy workability.

Slate is a rock resulting from mud or clay which has been subjected to such great heat and pressure that the original minerals have altered almost completely to new minerals having tabular crystals rearranged along definite and pronounced cleavage planes. Slate is generally blue black to dark gray in color with light gray, green, and red shades occurring in restricted areas. The texture is fine-grained and uniform, and the material is characterized by the facility with which thin, dense, hard sheets may be prepared.

REQUIREMENTS FOR RESIDENTIAL STONE

No single formula covering desirable physical or chemical properties for residential stone can be set forth which will apply equally to all stones. Certain general requirements, however, may be mentioned.

Strength

Stone construction is always associated in the mind of the public with substantiality. The usual building stones are inherently strong, but any stone that is sound structurally will have adequate mechanical strength for residential building.

Durability

The durability of a good natural stone likewise is usually more than ample to meet the probable term of useful occupancy. Good stone laid up with proper mortar should last for generations. Inferior material, which always should be avoided, includes badly weathered rock that might occur near the surface, greatly shattered or broken material, rock consisting of aggregates poorly cemented together, or rock too soft or too easily soluble to make good building stone. Sufficient time should be allowed, of course, between removal from the quarry and ultimate use so that the stone will be adequately seasoned.

Texture

Both fine-grained, homogeneous stone, and coarse-grained material are used in residential work. Choice is largely a matter of personal taste and judgment on the part of the buyer, governed by the availability of the stone.

Structure

Joints, bedding planes, or other seams or fractures in stone intended for residential work may be highly desirable or may entirely unfit the stone for structural use, depending upon their frequency and kind. The rock may be unsuitable for building purposes if undesirable seams or bedding planes occur closer together than the final dimensions of the building blocks. On the other hand, such structural characteristics are of advantage where the breaks occur more or less conformable to the size of the ultimate building unit. The planes of weakness or fracture then may be utilized in quarrying and shaping practice.

An example of a satisfactory building stone is a granite gneiss which has been so stressed that many joint planes have developed. Slabs and blocks of stone are readily pried loose from the quarry face with bars. Very light blasting is occasionally necessary. The face of the joints is attractively iron stained and these surfaces commonly are left for the exterior of the final masonry. As the stone is sound between these joint planes, the seams in this instance contribute greatly to the salability as well as the workability of the material.

With certain sandstones or quartzites, the natural bedding planes permit slabs to be split out readily. If the rock is too thinly bedded and the bedding planes are weak, the rock may be unfitted for structural purposes.

Massive rock, showing no seams or joints, may be more difficult and costly to shape. Massive limestone, or marble, however, yields readily to gang saws, Carborundum saws, diamond saws, or wire saws. Most true granite, even though it exhibits few or no seams or fractures can be split readily along the rift and grain.

Color

Pleasing and distinctive color in a building stone is an important asset. Shades of gray, cream, buff, and light brown are popular in modern architecture. Other colors such as pink and red also are widely used where available. Warmth and life in color work seem among the first requirements, as dingy, drab, or dirty-looking material may be hopelessly unattractive. Color appeal is being capitalized by some quarry operators whose stone is distinctive and attractive.

DIMENSIONS OF RESIDENTIAL STONE

Sizes of stock offered for small-home construction vary somewhat to conform with the physical condition of the stone in the quarry. Quarrymen utilize natural seams where circumstances permit and the nature of the product is governed by such factors as kind and frequency of bedding planes, and kind and number of joint planes.

An examination of the size of quarry stock of a few large quarry operators who are active in the residential building field indicates the general types and sizes of building stone now on the market. Data here given include granite, limestone, and sandstone.

A quarrier of granite dimension stone offers to builders a rubble for ashlar work. For illustration, a block of granite from the quarry stock may be roughly 6 feet long, 2 feet wide, and 1 foot 6 inches thick. Such a block is split by shims and wedges in shallow drill holes into blocks 2 feet by 1 foot by 1 foot 6 inches. Blocks of this size are further split into pieces approximately 2 feet by 1 foot by 6 inches.

These slabs are ready for shipment to the building site. Two dimensions are established by the quarry operator. The width is the height of the stone as set in the final wall - in this case 1 foot. The thickness - 6 inches - remains unaltered. Lengths, however, are broken by the mason or his helper to fit the general wall style.

The dimensions of this rubble stock are random within the following limits; length 1 foot to 4 feet, rise 8 inches to 16 inches, thickness 5 inches to 8 inches. Such rubble strips need be broken but once or twice to provide building stone of final dimension. Included in the stock is a sufficient quantity of thicker pieces from which to make heavy returns, jambs, and other pieces of odd size.

The surface of these blocks is the broken texture of a hard granite which has been broken carefully along the rift and grain. Its relatively low selling price does not permit shaping or other manufacturing processes, but if desired, ashlar quarried to specific dimensions is provided. One ton of this one- and two-man rubble furnishes from 18 to 24 square feet of masonry veneer.

A producer of limestone for building purposes places upon the market material which has been sawed on four sides. These strips are broken to desired lengths upon the building site by the mason contractor. The sawed surface varies considerably in texture depending upon the process of sawing employed, different effects being secured by using various sizes of sand and steel shot.

The thickness of these strips is usually 4 inches, although material as thin as 3 inches sometimes is used where building codes permit a lighter type of construction. The length of the strips is random from 3 feet to 5 feet. The width of the strips corresponds to the height of the units desired. For usual work three unit heights are recommended, although four are sometimes used. The preferred unit heights are as follows: A, two units - 4 inches and 8½ inches; B, three units - 4 inches, 8½ inches, and 13 inches; C, four units - 5 inches, 7¾ inches, 10½ inches, and 13¼ inches. Thus the thickness of the final stone in the wall is uniform, usually 4 inches, the height of the wall units corresponds to the width of the strip, and the length is determined on the job by the judgment of the mason contractor.

No lengths more than 3½ times the height nor less than 1½ times the height are recommended. Mortar joints are one half inch thick. Where a masonry backing is used, approximately 10 percent of the wall area consists of bonding stones 6 or 8 inches thick, tying the stone wall securely to the backing.

Dimensions of a well-known sandstone for residential work are as follows: Height 4 inches to 18 inches, thickness 4 inches (8 inches for bond stones), and lengths random but should be at least 1½ times the height averaging about 24 inches. No lengths greater than 50 inches are recommended. These specifications are for ashlar sawn with sand, chat, or shot, depending upon the texture desired.

Specifications for split face material are as follows: Heights 2 inches to 10 inches, standard thickness 4 inches (8 inches bond stones), and length 1½ times the height. The stock heights (or widths of strips as sold to the trade) are 2½ inches, 4 inches, 5½ inches, 7 inches, and 8½ inches. One-inch heights are also available at a slightly higher price. One-half-inch mortar joints are recommended.

For small-house construction, heights of 2½ inches, 5½ inches, and 7 inches are recommended. By using these heights in split face ashlar work, a good random effect is achieved by making 12 percent of the wall in 2½-inch heights, 46 percent in 4-inch, 26 percent in 5½-inch, and 16 percent in 7-inch heights. Where an additional height unit of 8½ inches is used, these

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proportions may be modified so that the wall consists of 10 percent of $2\frac{1}{2}$-inch heights, 25 percent of $4\frac{1}{2}$-inch, 40 percent of $5\frac{1}{2}$-inch, 15 percent of 7-inch, and 10 percent of $8\frac{1}{2}$-inch heights.

Material is also available in the form of split face and sawed beds from which to make building units of standard brick dimensions (8 by $2\frac{1}{4}$ by $3\frac{3}{4}$ inches). This material is prepared in what one company calls brick strips $2\frac{1}{4}$ inches in height, $3\frac{3}{4}$ inches in width, and 6 inches to 36 inches in length.

Another sandstone company places building stone upon the market 4 inches to 15 inches in height, up to 20 inches in length, and 4 inches in thickness. It recommends that the length be about twice the height.

CONSTRUCTION METHODS

In modern construction natural stone is usually employed as a veneer, the several kinds of building stones requiring somewhat different practice which varies more in detail than in principle. Such variations are in reality a common-sense conformance to the physical properties and character of the particular stone.

Stone veneer for residences is applied as a facing over some form of backing which may be either frame construction, hollow tile, concrete, common brick, cinder blocks, Haydite, or other lightweight aggregate, or a combination of these or other building units.

Stone veneer over frame construction is probably the lowest-cost type of stone-faced wall. The stone veneer may be 4 inches or more in thickness where sawed stone or its equivalent is used, although exceptionally it is only 3 inches thick. For split stone such as granite, a 5- to 7-inch veneer is commonly recommended. A waterproof building paper or some similar material is placed between the wood sheathing of the frame construction and the masonry. Galvanized or rustproof metal anchors tie the masonry to the studding. The anchor heads are imbedded in the mortar joints or are bent down into niches hewn in the stone if the stone used is soft enough to be cut easily. Upon the interior faces of the studs any system of lath and plaster construction or its equivalent is used.

With backing of hollow tile, common brick, or other material, the stone veneer is bonded by rustproof metal anchors or by means of bond stones which firmly lock the veneer to the backing.

For best results the mortar is carefully prepared by experienced workmen and from selected materials. Proportions sometimes recommended are 2 parts lime, 1 part cement, and 9 parts of sand. The cement should be nonstaining and the sand should be well washed and well graded.

Construction details are variable and depend to some extent on building codes. The stone producer is usually guided by the advice of architects as to the most efficient way of utilizing the particular stone in question.

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DEPRECIATION AND MAINTENANCE

Because of its permanence, stability, attractiveness, and low maintenance cost, natural stone is a highly favored material for residential as well as for other types of construction wherein depreciation and maintenance are important items to be considered. More and more stone is being used in medium-priced dwellings for which the initial outlay is no less important than the first cost plus maintenance over a term of years. Comparative figures are lacking for maintenance cost of stone as against other construction, but the saving with stone or other masonry is generally conceded. As the significance of depreciation as applied to dwellings is not generally realized, the following data are of interest (table 1):[3]

Table 1. - Probable useful life and depreciation rate of dwellings

	One-family dwelling		Two-, three-, or four-family dwelling	
	Probable useful life, years	Depreciation rate, percent	Probable useful, life, years	Depreciation rate, percent
Masonry, brick, concrete, reinforced concrete, brick and steel, steel frame, steel and stucco (fireproof)	50	2	45	2¼
Masonry, slow-burning, with or without steel frame	50	2	40	2½
Masonry with frame interior	50	2	33	3
Frame	33	3	30	3-1/3

The difference between a depreciation rate of 2 percent and 3 percent obviously amounts to $50 a year on a $5,000 home, or 6 percent of $833, a sum which therefore might be a wise investment for more durable constructions. Possible savings in fire insurance premiums are also worthy of mention.

MARKETS

A popular, widely advertised stone may find buyers many hundred miles from the quarry. Ordinarily, however, the small producer or contractor is dependent upon local markets until his product achieves wider recognition. The most successful producers of residential stone have introduced their products gradually, fostering local outlets and allowing the demand to grow as it will, slowly and normally, and encouraged by contacts which the quarry operator is able to make. Each house or other structure built of a distinctive building stone is a perpetual advertisement of the quarryman's product. The effect upon the prospective buyer is proportional to the number of such buildings, and to the artistic effects secured.

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[3] U. S. Treasury Department, Depreciation Studies, Preliminary Report of the Bureau of Internal Revenue: January, 1931, p. 3.

The market area of any given residential building stone is limited largely by the demand for the stone balanced against the increasing cost of the material, as transportation to greater distances from the quarry adds to the ultimate cost to the consumer.

Residential building normally accounts for one third to two fifths of the total value of construction contracts in the United States. The value of residential construction contracts alone in 1929 was about two billion dollars. Table 2 shows the relative importance of the several geographic districts in 1929. Data are partly from F. W. Dodge Corporation statistics.

Data regarding estimated building expenditures as ascertained from building permits in the larger cities are gathered currently by the United States Bureau of Labor Statistics. In 1928, for example, a survey in 310 cities with a total population of 44,940,049 indicated a per capita expenditure of $39.22 for housekeeping dwellings only. This figure varied from a minimum of $0.26 per capita in Butte, Mont., to a maximum of $243.64 per capita in Yonkers, N. Y.

During 1931 and 1932 a study was made by the Bureau of Labor Statistics regarding the relative cost of labor and material in building construction.[4] Data were gathered in 15 cities thought to be fairly representative of general conditions: Namely, Atlanta, Boston, Chicago, Dallas, Duluth, Indianapolis, Little Rock, New Orleans, New York, Roanoke, Saginaw, St. Louis, Salt Lake City, Seattle, and Trenton.

The investigation indicates that as an average for the 15 cities the residential-building dollar is spent as shown in table 3.

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[4] Bureau of Labor Statistics, "Relative Cost of Material and Labor in Building Construction 1931-1932." From the Monthly Labor Review, October, 1932, United States Department of Labor.

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Table 2. - Residential contracts awarded in 1929, by territories[1]

District	Value residential contracts awarded (In millions and tenths of millions of dollars)	Percent of total
Metropolitan New York and vicinity	551.1	25.6
Chicago	315.4	14.6
Middle Atlantic	246.2	11.4
Western	239.5 (estimated)	11.1 (estimated)
Pittsburgh	166.1	7.7
New England	153.3	7.1
Southern Michigan ...	108.3	5.0
Southeastern	90.7	4.2
Kansas City	77.7	3.6
St. Louis	70.2	3.3
Texas	60.2	2.8
Up-State New York ...	41.4	2.0
New Orleans	17.9	0.8
Central Northwest ...	17.2	0.8
Total	2155.2	100.0

[1] Metropolitan New York and vicinity includes northern New Jersey, New York City, Long Island, Westchester, Orange, Putnam, and Rockland Counties, N. Y.

Chicago includes northern Illinois, Indiana, Iowa, and eastern and southern Wisconsin.

Middle Atlantic includes eastern Pennsylvania, southern New Jersey, Maryland, Delaware, District of Columbia, and Virginia.

Western includes California, Washington, Oregon, Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico.

Pittsburgh includes western Pennsylvania, West Virginia, Ohio, and Kentucky.

New England includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

Southern Michigan consists of the southern peninsula.

Southeastern includes the Carolinas, Georgia, Florida, Alabama, and eastern Tennessee.

Kansas City includes western Missouri, Kansas, Oklahoma, and Nebraska.

St. Louis includes southern Illinois, eastern Missouri, northeast Arkansas, western Tennessee, and northwest Mississippi.

Texas includes the State only.

Up-State New York includes all counties north of Orange, Putnam, and Rockland.

New Orleans includes Louisiana, western and southern Arkansas, and eastern and southern Mississippi.

Central Northwest includes Minnesota, the Dakotas, northern peninsula of Michigan, and northwest Wisconsin.

Table 3. - Distribution of residential building costs by class of work and cost of material
(Average of 15 cities)

Class of work	Percent of total cost chargeable to specified class	Percent of total cost chargeable to material cost in specified classes
Excavating and grading	1.3	0.02
Brick work	14.8	8.6
Carpenter work (builders' hardware, lumber, and millwork)	27.3	18.3
Tile work	3.5	2.0
Concrete work	11.7	7.4
Electric wiring and fixtures	4.5	2.9
Heating and ventilating	6.6	5.3
Plumbing	10.1	7.6
Plastering	8.2	3.7
Painting	4.2	1.4
Papering	.5	.2
Roofing	1.8	1.2
Miscellaneous	5.5	4.1
Total	100.0	62.7

As indicated by this study, of every dollar that is spent in residential construction, 62.7 cents goes for material. Of this 62.7 cents 8.6 cents is spent for brick, 18.3 cents for lumber and related supplies, 2.0 cents for tile, and 7.4 cents for cement, sand, and gravel, or other aggregates or material pertaining to concrete work.

Expressed in general terms, the estimated expenditures in 1928 for building material to house one person amounted to about $3.38 for brick, $7.20 for lumber and related material, $0.79 for tile, and $2.90 for materials of which to make concrete.

An "average" American city of 100,000 inhabitants might therefore provide an annual market of $338,000 for brick, $720,000 for lumber and related material, $79,000 for tile, and $290,000 for concrete material, on the basis of the 1931-32 distribution study and of the 1928 building volume.

It is at all times dangerous to apply broad generalizations to specific cases, and it should not be assumed that any one city will provide a building-material market of the foregoing dimensions. Some communities absorb and use much more material per capita than others. The figures presented here are merely to indicate the possible extent of the market for residential building stone in the average community.

SALES PROBLEMS

Sales methods have been studied carefully by a number of quarry operators catering to the residential market, but no detailed account can be given here of the various means by which residential stone generally is sold. A few of the more common selling channels are mentioned, however, because the problems thereof differ somewhat from those pertaining to distribution of other building materials.

Commodities such as brick and lumber are more or less standard products stocked by most building supply dealers, but no uniformity of size, shape, or style prevails among the many building stones upon the market, nor are natural stone units stocked extensively by dealers. Much building stone is sold by the producer direct to the ultimate consumer with whom sales contacts are made direct or through architects and masonry contractors.

Only the very large and well-established quarry operator can afford to advertise nationally, and only a few stone districts can hope for a nationwide market. The enormous expense of national publicity is justified only when a long campaign is contemplated, as immediate results may be somewhat intangible. For the small operator, advertising of this kind is out of the question. Some producers find it advisable, however, to stimulate public consciousness of their material by judicious advertising in local papers and trade journals. The publicity resulting from people's actually seeing a stone in structures that are popularly priced is considered one of the surest and cheapest forms of advertising.

One quarrier of an attractively colored building stone within a few miles of a city of a half million people has developed a market principally by creating an interest in structures in which his material is employed. His markets are local. His product was introduced slowly at first through the construction of several small buildings such as filling stations and residences. These jobs began to bring the stone to the attention of builders and the public. Each new job increased the demand for his stone and a profitable and expanding business has grown up with no great amount of selling expenses.

Quarry operators have found it advisable to establish definite contacts within the logical trade area for their stone. Certain producers acquaint architects with the different color effects that are possible, the sizes that are most economically available, the workability of the stone, and other facts relevent to the product. The architect's attention is often gained by personal contacts, by display of samples of typical color effects and textures, by invitation to visit the quarry, and by personal letters, pamphlets, or by general advertising constantly reminding him of the stone in question. It has been found that architects encourage the use of meritorious building stone because an attractive, well-built, and well-designed stone residence is an advertisement for the architect as well as for the stone itself.

Quarry operators not infrequently receive suggestions from the architect as to innovations and improvements in shape, size, or color selection of the building unit. The producer generally cooperates with the architect insofar as his ability permits, for such friendly relations and good will are of obvious benefit.

Residential stone producers also find it of advantage to foster friendly relations with mason contractors, and to see that the workmen are sufficiently well acquainted with the properties of the stone to use it in the most economical and desirable manner. Mason contractors, moreover, have valuable contacts with builders and contractors through which to further the sale of a particular stone. A cordial relationship with contractors may be built up by the same methods as have been suggested for contacting architects.

Some producers of residential building stone are prepared to furnish real assistance to customers after the stone leaves the quarry. Recommendations are often made to the mason or contractor as to setting the stone, the mortar to be used, and other precautions to insure long life of the masonry.

Details are important; for example, one stone operator strongly recommends that his product shall be pointed only with mortar that harmonizes well with the stone, usually just a shade or two darker in color than the tone of the stonework. Perhaps more operators will realize eventually that every job, large or small, represents a permanent advertisement of the quarry which will either help to sell more stone or will increase "sales resistance."

OTHER OUTLETS FOR STONE IN THE RESIDENTIAL FIELD

Quarry operators catering to the residential home field have found that other markets exist for their product in addition to the stone used only for wall construction. Certain natural stones are used for interior trim, fireplaces, flagstones, and for miscellaneous landscape effects such as sundials, bird baths, rock gardens, and aquariums.

Nearly any sound building stone may be used successfully in fireplace construction. One large company offers to builders a series of fireplace designs for which their stone is sawed to exact dimension so that the builder may purchase a complete stone fireplace which needs only to be assembled upon the job.

Fabrication of stone intended for such uses as fireplace construction suggests a considerable field for producers of stone that has unique color or other property of decorative value. Merchandising stone in this manner is merely applying factory methods to specialized products. It is possible that the idea could be used in a similar way for a variety of outdoor uses.

The various landscape effects that can be achieved by the use of natural stone furnish an attractive outlet for much stone that is otherwise unadaptable for standard types of construction. Such specialty markets do not

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consume spectacular tonnages of material, but where such units are fabricated at the quarry and virtually "packaged" for the consumer the return would be much greater per ton of stone than for the more usual outlets.

It would seem, also, that this specialty market could be developed further by offering to the small-home owner a variety of units which he can assemble himself at relatively small expense and with a minimum of labor. Some of the largest magazines catering to country or suburban people have built up their enormous circulations chiefly on the policy of telling their subscribers "how to do it." This same principle might be turned to account by stone producers, who could package their products so that the buyer could assemble the stone pieces into their final form with a minimum of hard work.

Many types of stone products are adaptable as flagstones both for porches and for walkways. Sandstone and slate for example, are used for porches, walkways, pattern walks, stepping stones, terraces, and steps. Artistic effects are achieved by using multicolored stone flags set in irregular fashion. Incidentally the story is told of a man who imported an expensive Italian marble with which to construct a certain walkway upon his country estate. In the course of time the marble slabs were received and were carefully laid by the contractor in a regular and uniform fashion. The owner, however, was disgusted with the finished walk and immediately ordered it torn up. He then procured a heavy sledge hammer and proceeded to break the marble flags into all sorts of shapes, much to the bewilderment of the contractor. The irregular fragments were then relaid, producing a much more beautiful walk than before.

Slate is perhaps the only natural stone readily amenable to roof construction. Among the advantages of a slate roof may be mentioned exceptional durability and imperviousness to the weather. Certain slate roofs have been known to render adequate service for many hundred years. Also very attractive color patterns are possible. The harmony that exists between slate roof and stone exterior appeals to many architects and home owners.

No modern home is complete without adequate provision for heat and cold insulation, not only in the walls but also in the roof construction. Of the natural stones, pumice stone and certain kinds of massive diatomite have been used for insulation purposes. Pumice stone is used extensively in Italy for wall construction and to a lesser extent in a few of the western States. Diatomite has been used to a slight extent in California and one or two other western States as a sawed brick for wall construction. In powdered form it has been used as an insulation fill in walls and between joists in ceilings.